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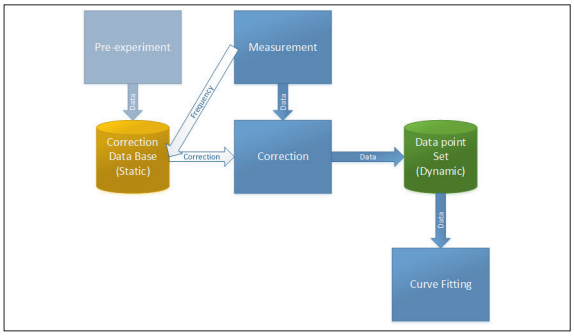
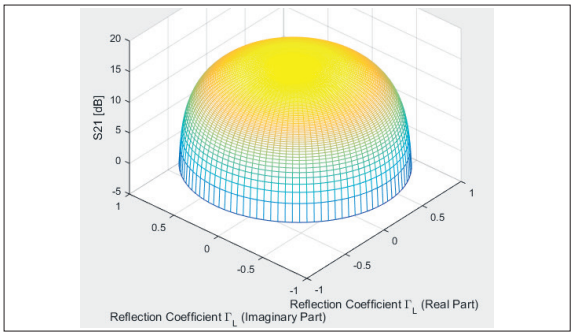
Subject Area	Wireless Communications

Source and Load Pull for Gain and Noise Figure Measurement

NF measurement in unmatched systems



Measurement system structure

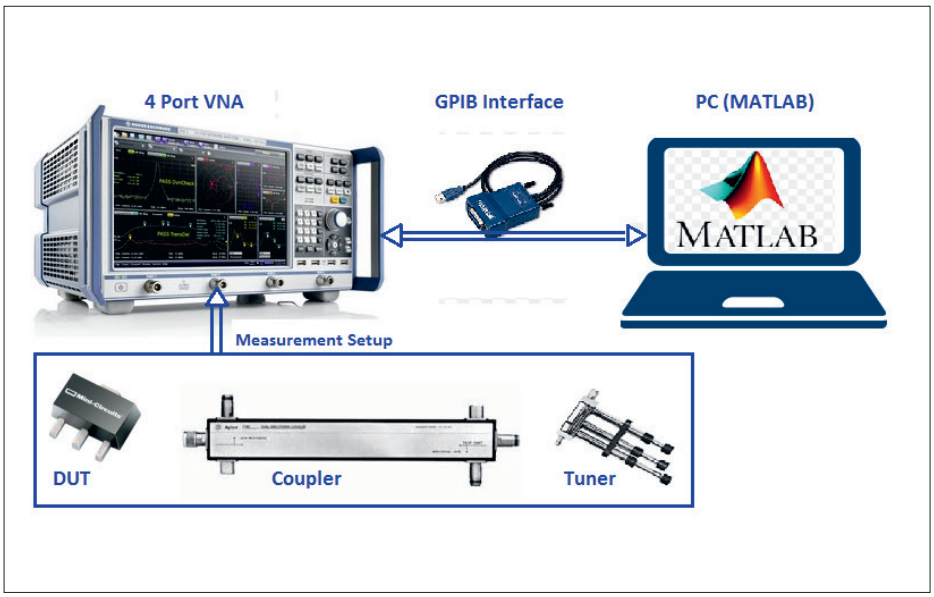


Power gain surface above Smith Chart

Task: The gain and the noise figure are the most important parameters for microwave low-noise amplifier design. In unmatched systems, there are reflections on the transmission line, which results in an overlap of forwarding and reflected wave, as well as a voltage distribution on the transmission line. In this thesis, a system for power gain and noise figure measurement in unmatched systems is designed. Our approach consists of a relatively low-cost setup and an efficient analysis system for measured data. The goal of the thesis is to implement an efficient and low-cost measurement system which measures the RF parameters (power gain, noise figure) of an active device (amplifier) and the impedance at the same time. In the end, the former will be expressed as a function of the latter in a non 50 Ohm environment.

Objective: First of all, an accurate measurement setup needs to be designed, which measures the data needed for the later analysis. For power gain measurement, we need to measure the voltage level on the transmission line, so the vector network analyzer (VNA) is chosen as the measurement device. The data will be stored in a database and then be used to estimate the other data points. If we plot the gain or noise figure in the vertical dimension on an impedance plane (Smith Chart), it shows up as a surface in a 3D space. A curve fitting approach is used to fit the data points on the gain surface in an optimal manner. Finally, an automatic measurement procedure and a graphical user interface are implemented, which are controlled by a MATLAB script.

Result: With the measurement and analysis, the system plots a surface on the impedance plane (Smith Chart). The results demonstrate the system's ability of accurately measuring the power gain as a function of load impedance and estimating data on other points on the plane. An efficient and a low-cost measurement system is built. The measurement data corresponds relatively well with the theory. The intuitive GUI makes the measurement procedure easier to understand and use.



Measurement setup overview